US011898389B2

(12) **United States Patent**
Macdonald et al.

(10) **Patent No.: US 11,898,389 B2**
(45) **Date of Patent: Feb. 13, 2024**

(54) **TILTING DOOR SYSTEM**

(71) Applicants: **Mark Macdonald**, Ocala, FL (US); **Ryan Bosco Dsouza**, Ocala, FL (US); **Morey Wilkerson**, Ocala, FL (US)

(72) Inventors: **Mark Macdonald**, Ocala, FL (US); **Ryan Bosco Dsouza**, Ocala, FL (US); **Morey Wilkerson**, Ocala, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 153 days.

(21) Appl. No.: **17/080,328**

(22) Filed: **Oct. 26, 2020**

(65) **Prior Publication Data**

US 2022/0127887 A1 Apr. 28, 2022

(51) **Int. Cl.**
E05D 15/38 (2006.01)
E06B 3/50 (2006.01)
E06B 1/52 (2006.01)

(52) **U.S. Cl.**
CPC ***E05D 15/38*** (2013.01); ***E06B 1/522*** (2013.01); ***E06B 3/5018*** (2013.01); *E05Y 2201/684* (2013.01); *E05Y 2900/106* (2013.01); *E05Y 2900/108* (2013.01); *E05Y 2900/132* (2013.01)

(58) **Field of Classification Search**
CPC E05D 15/38; E06B 1/522; E06B 3/5018; E05F 15/668
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

663,989	A *	12/1900	Wilson	E05D 15/38 49/197
2,575,201	A *	11/1951	Tillotson	E05D 15/408 16/94 R
4,765,093	A	8/1988	Edwards	
5,337,520	A *	8/1994	Uribe	E05D 15/38 49/203
6,056,037	A *	5/2000	Jonkman, Sr.	E05D 15/262 49/362
8,245,446	B2	8/2012	Betker	
8,539,716	B2	9/2013	Betker	
8,769,871	B2	7/2014	Betker	
9,015,996	B2	4/2015	Betker	
9,091,107	B2	7/2015	Betker	
9,273,507	B2	3/2016	Petrat	
9,404,301	B2	8/2016	Betker	
9,428,951	B2	8/2016	Betker	
9,631,418	B2	4/2017	Crown	
10,208,529	B2	2/2019	Betker	
2016/0312512	A1 *	10/2016	Houser	E05D 13/003

(Continued)

FOREIGN PATENT DOCUMENTS

GB	2 155 991	*	10/1985

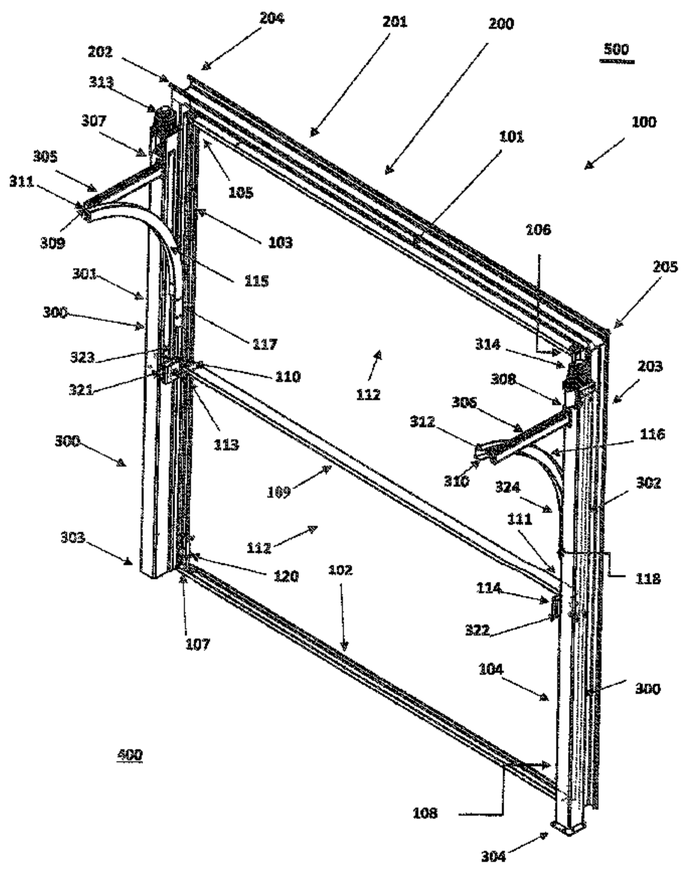
Primary Examiner — Gregory J Strimbu

(74) *Attorney, Agent, or Firm* — Gerard H. Bencen, ESQ; PATENT-ARTS

(57) **ABSTRACT**

A tilt-up door having vertical side members each having a pivot point, the pivot points move upward or downward when an actuator is activated to move the door between open and closed positions. First and second cams connected to the vertical side members at a lower end of the cams, each of said cams extend from the lower end thereof upwardly and arcuately toward an interior of a building to a distal terminal end thereof, each of the ends contacts a cam follower. The cam followers slide along the first and second cams and guide the first and second cams and the door as the door moves between the open and closed positions.

11 Claims, 5 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

2016/0376830	A1*	12/2016	Crown	E05D 15/38 49/199
2018/0002971	A1*	1/2018	Grace	E06B 3/483

* cited by examiner

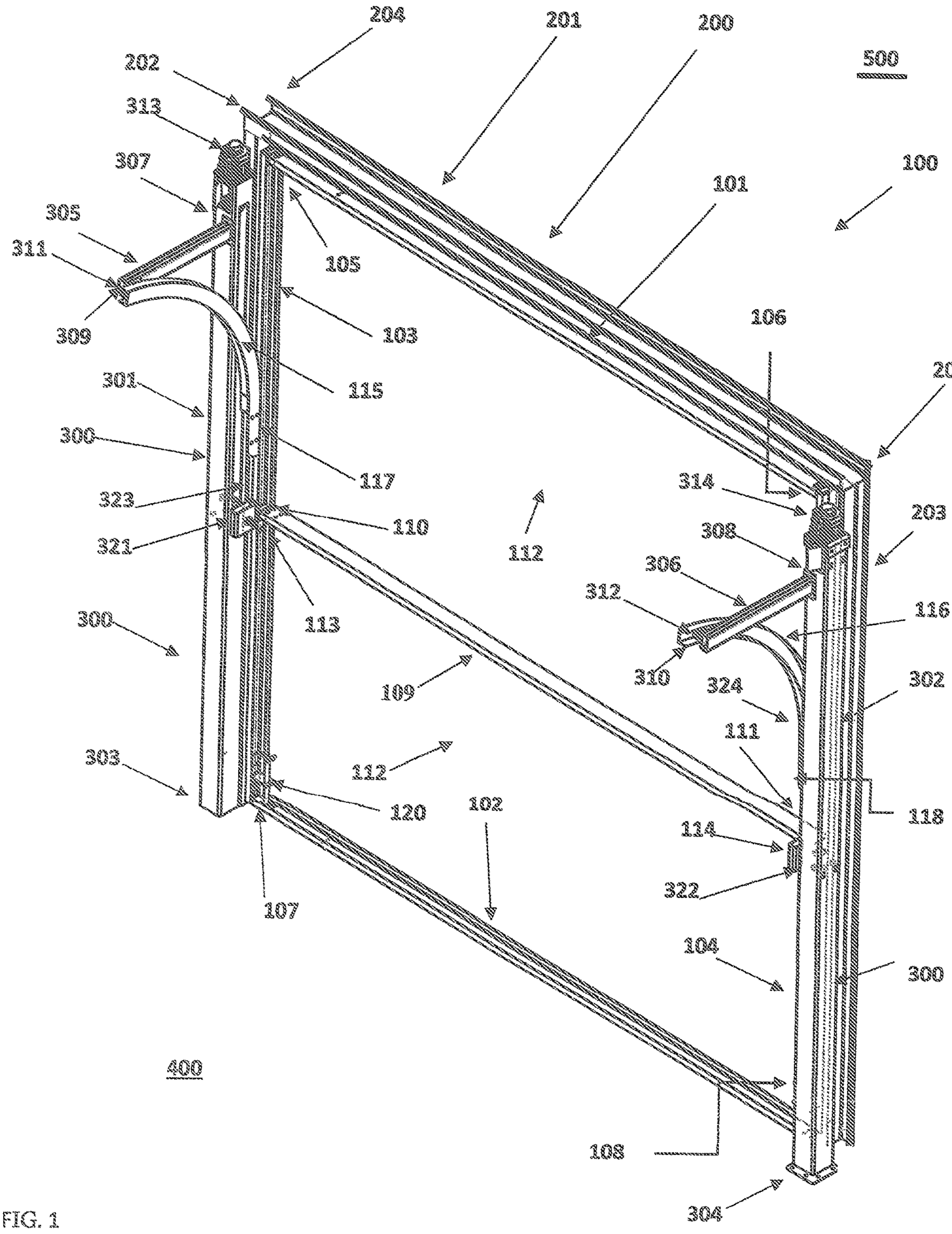

204
201
200
202
500
313
307
100
101
305
311
105
106
309
103
205
301
115
300
117
314
323
110
203
112
308
321
306
312
116
300
113
310
324
302
109
111
303
112
120
102
114
118
322
107
104
300
400
108
304

FIG. 1

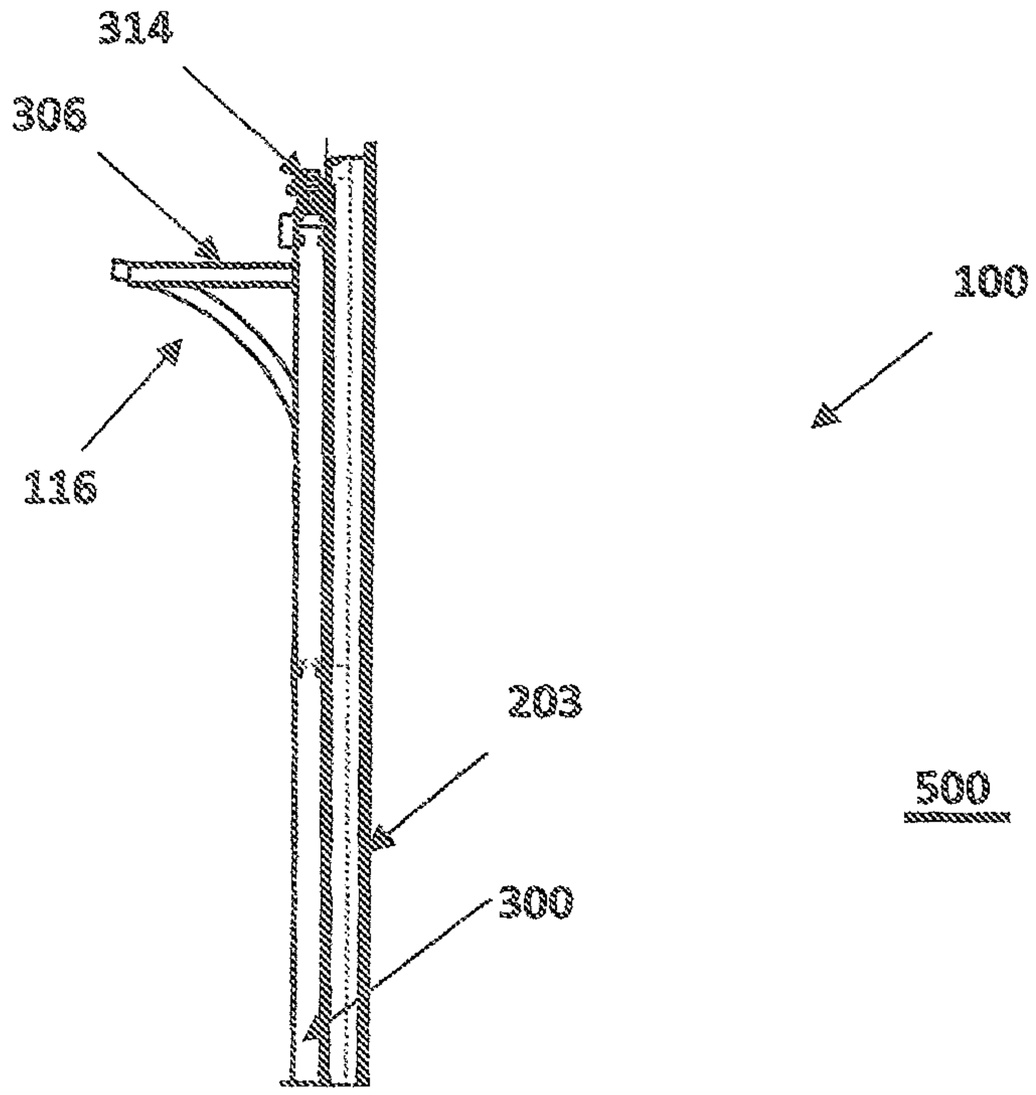

314
306
116
100
203
500
300
400

FIG. 2

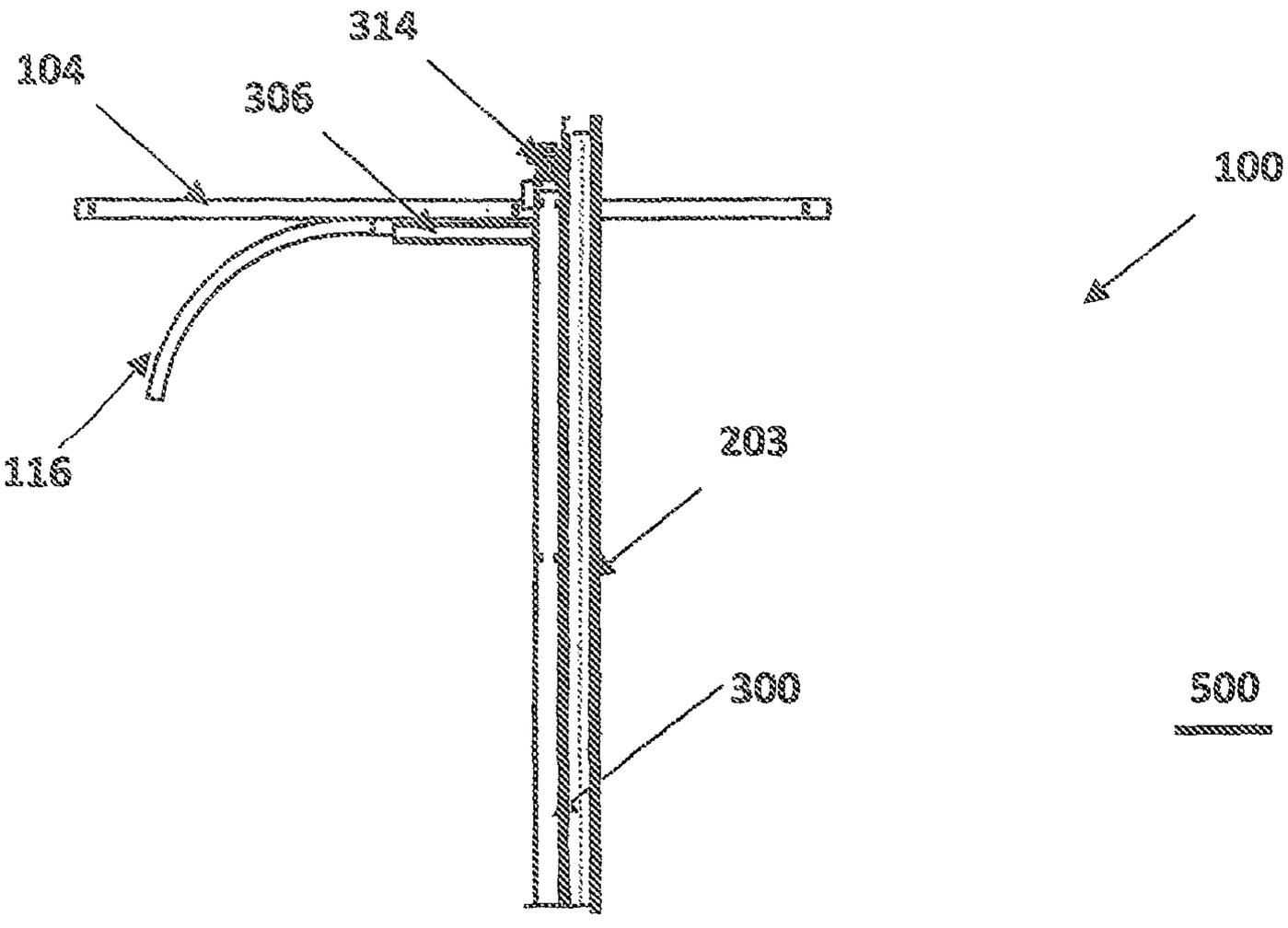

104
314
306
100
203
116
300
400
500

FIG. 2A

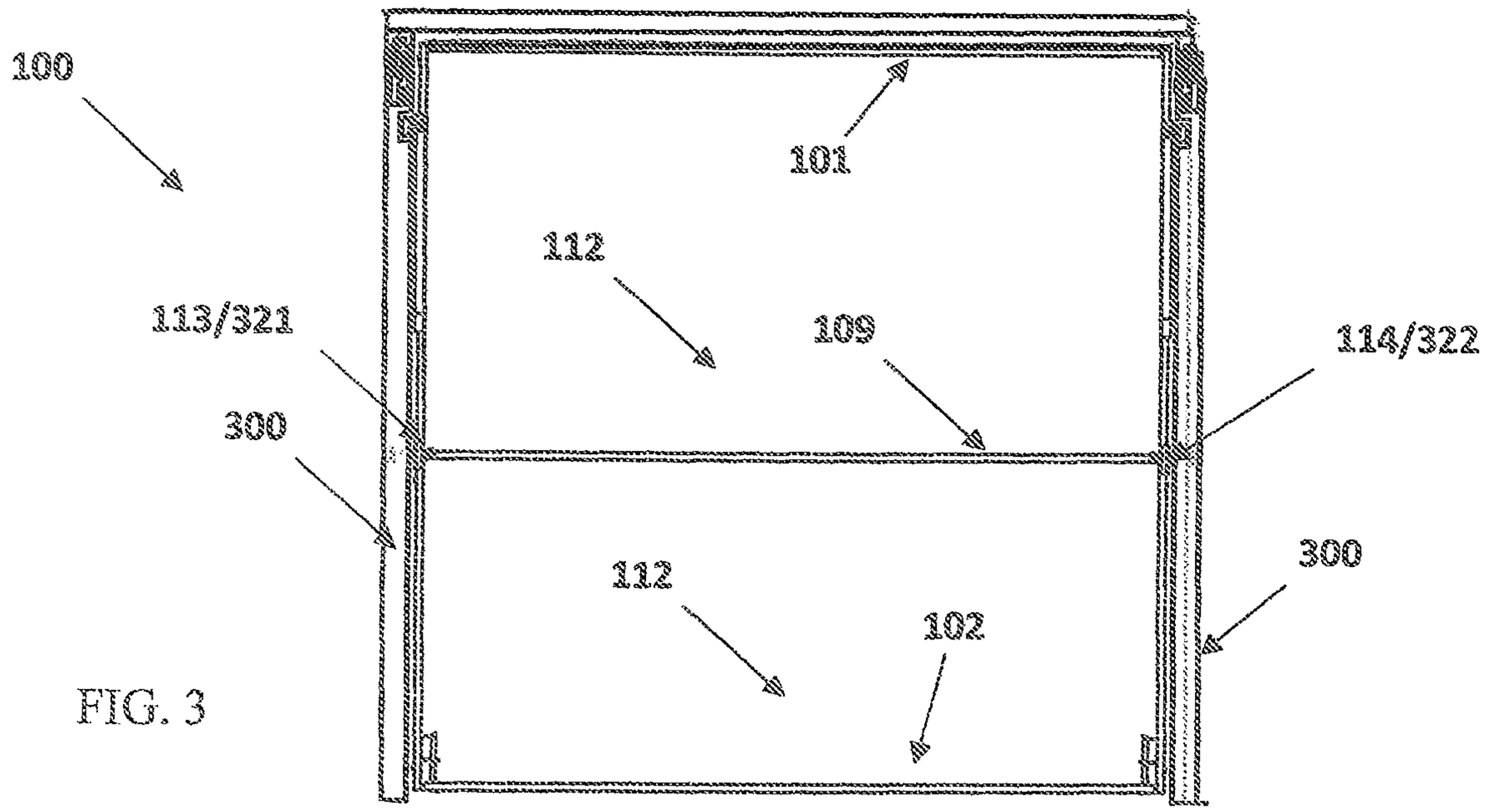

100
101
112
113/321
109
114/322
300
112
102
300

FIG. 3

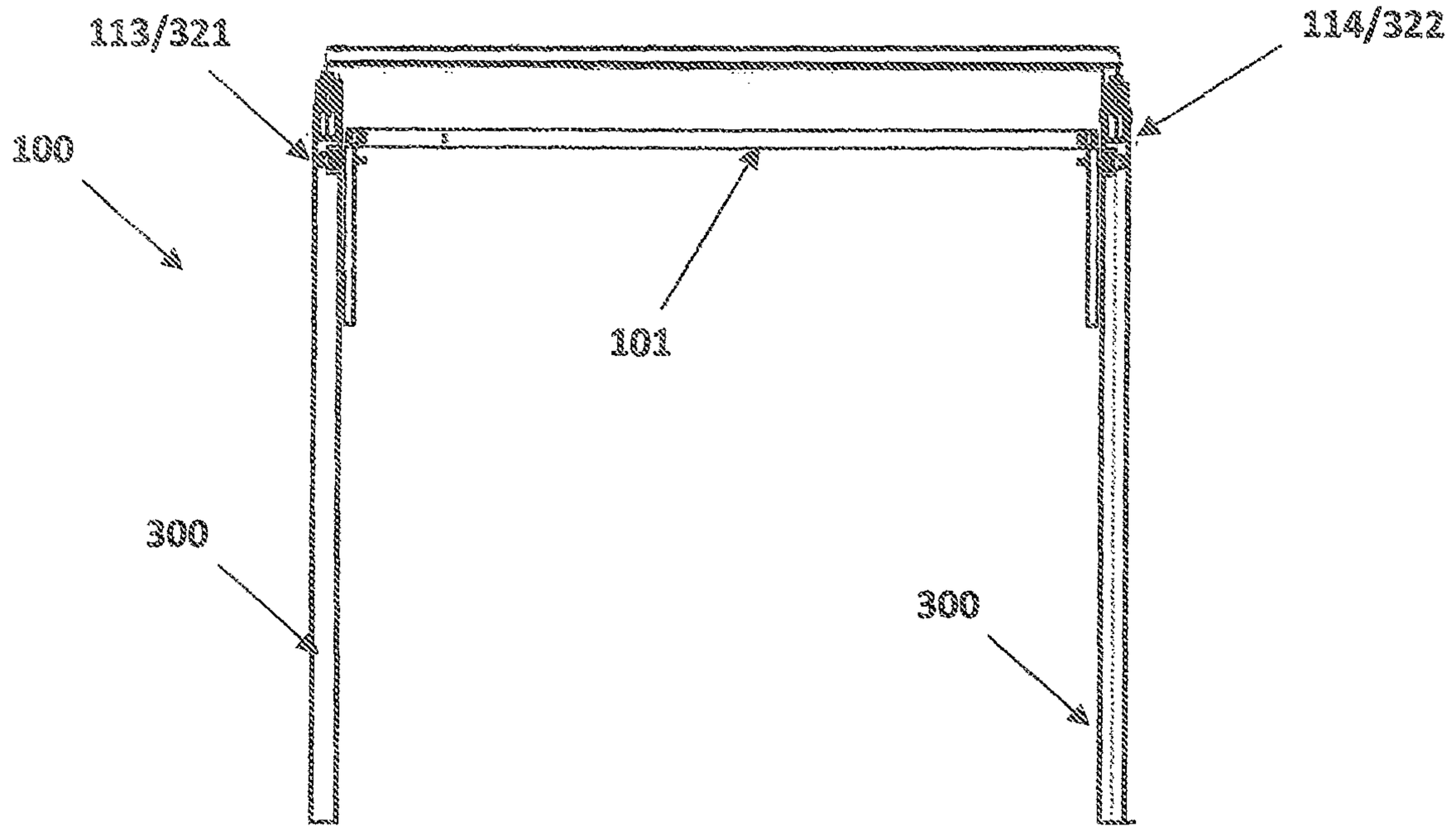

113/321
114/322
100
101
300
300

FIG. 3A

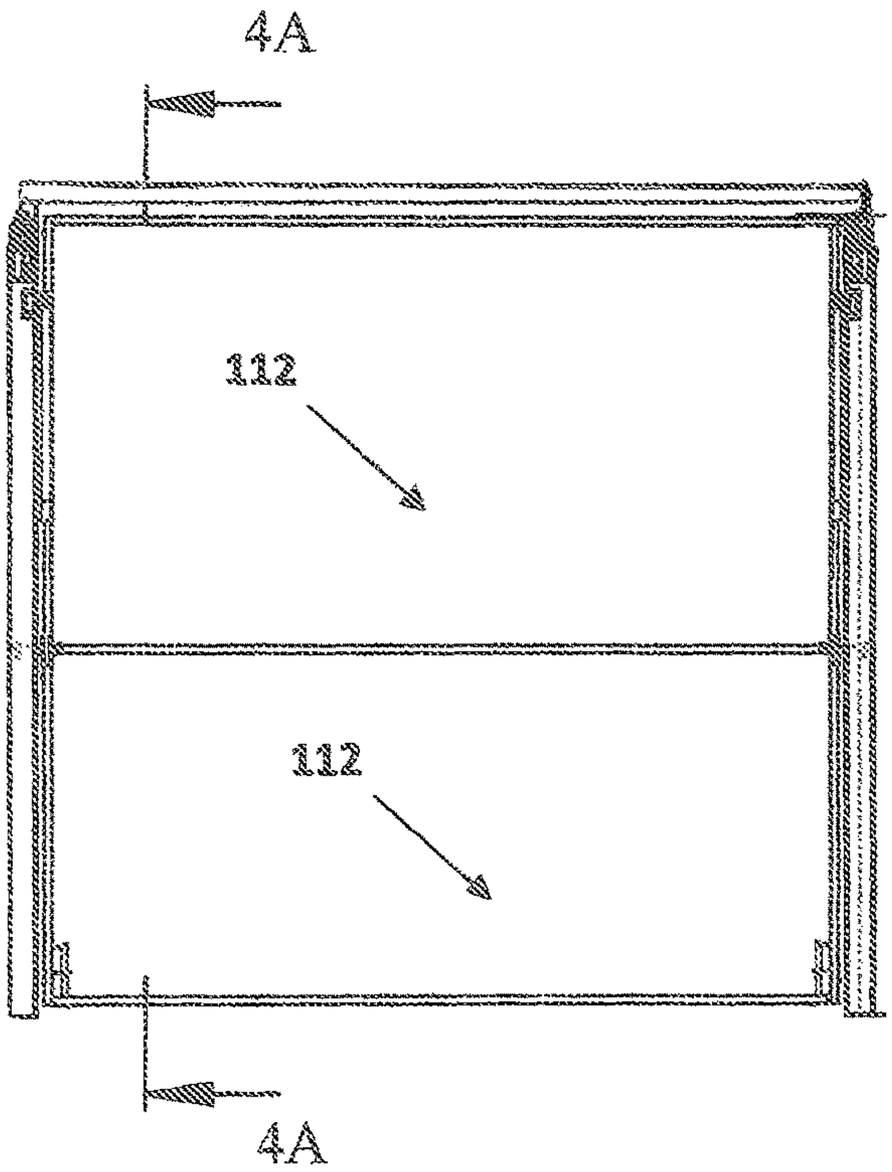


FIG. 4

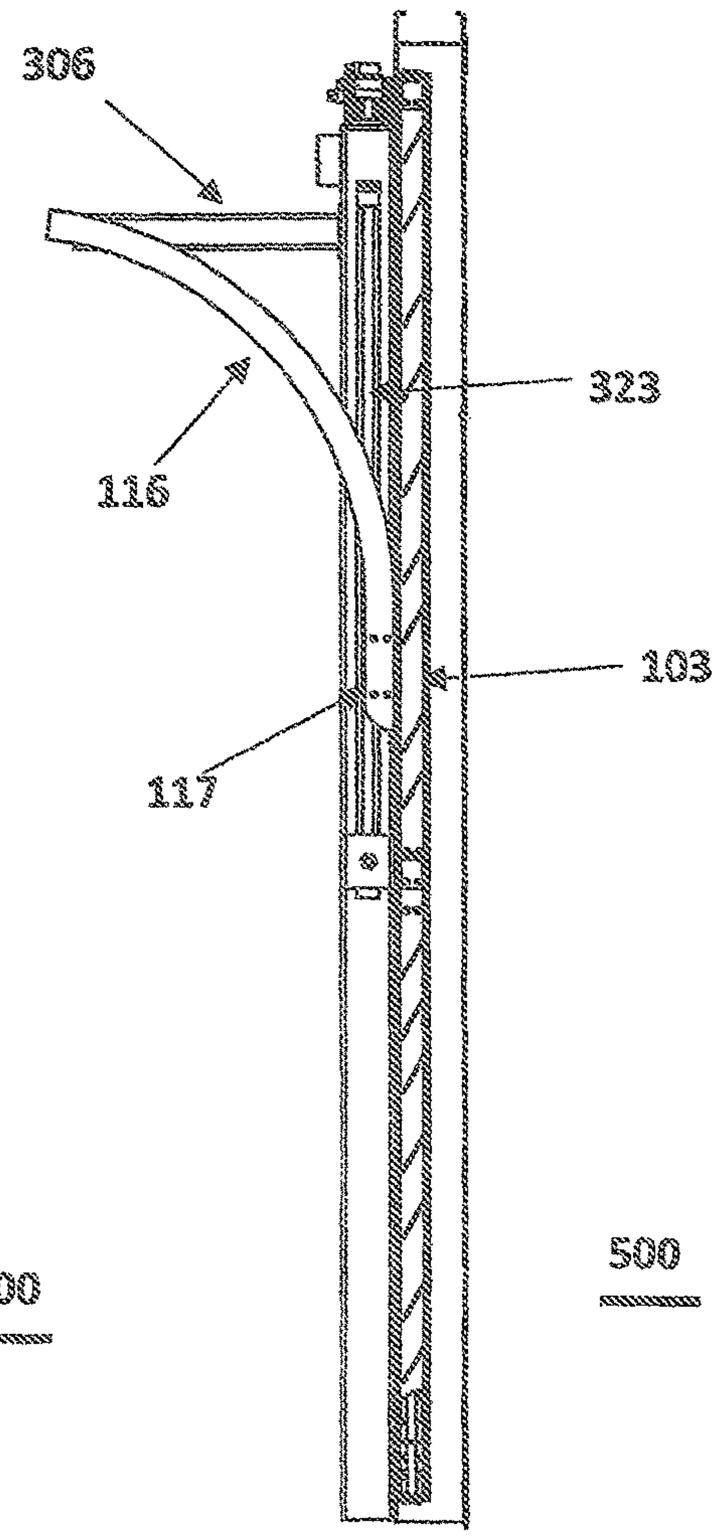


FIG. 4A

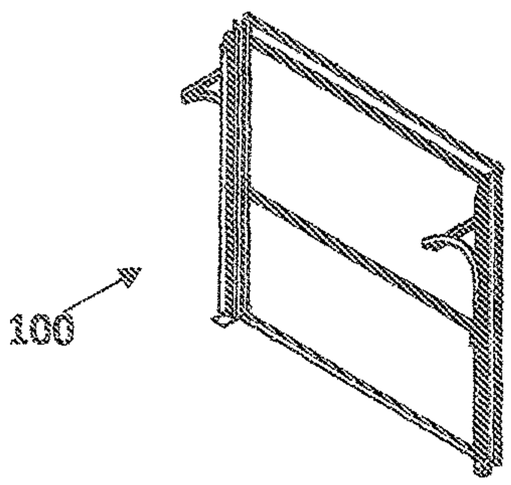


FIG. 5

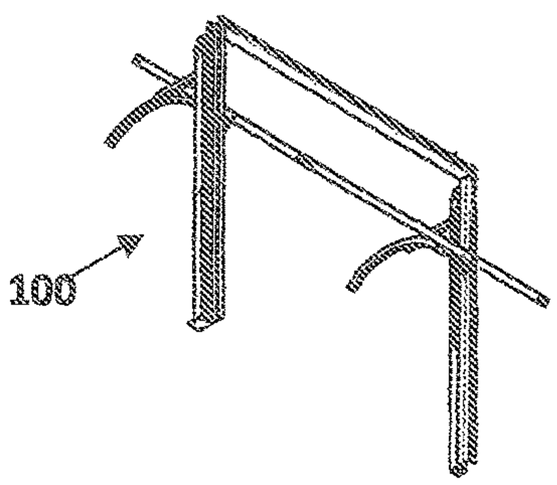


FIG. 5A

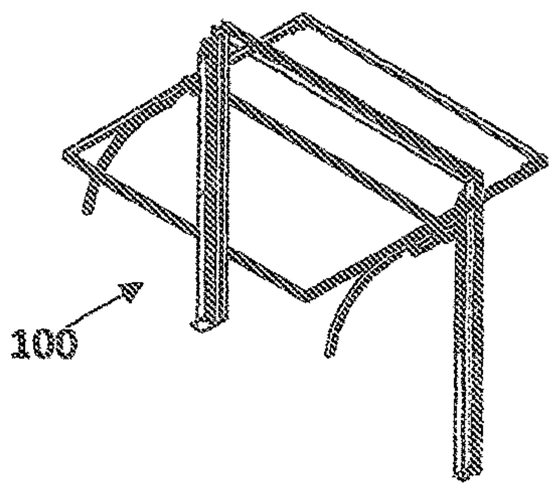


FIG. 5B

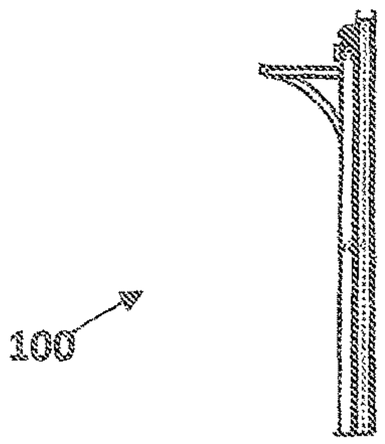


FIG. 5C

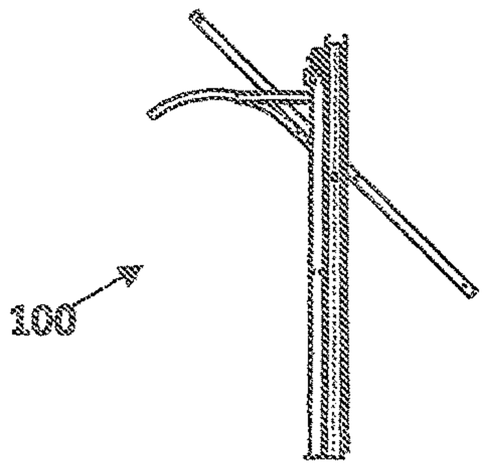


FIG. 5D

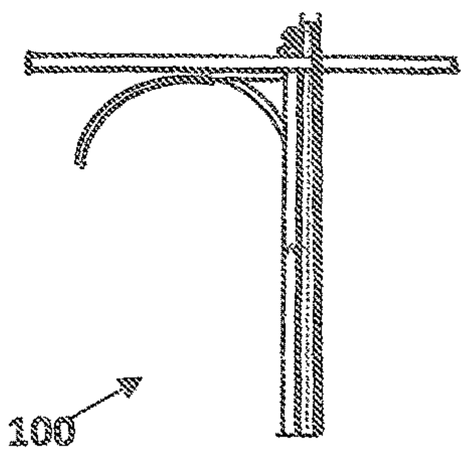


FIG. 5E

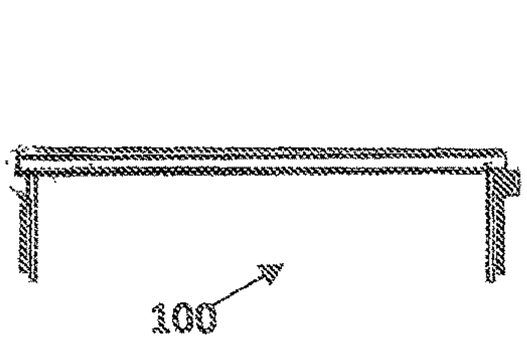


FIG. 5F

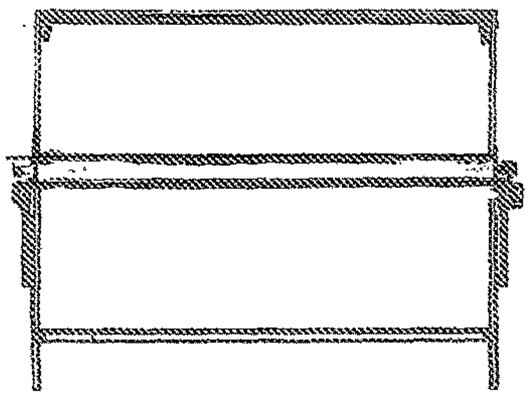


FIG. 5G

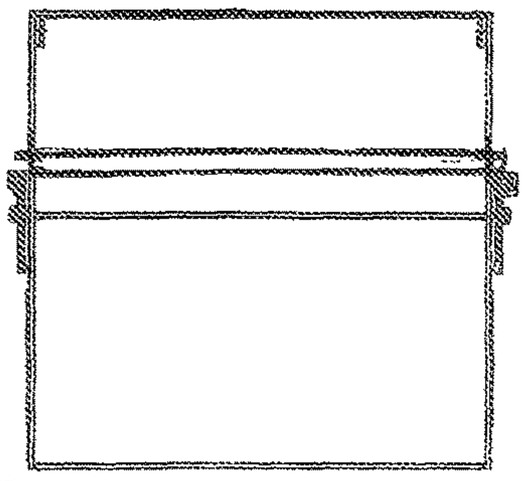


FIG. 5H

TILTING DOOR SYSTEM

FIELD OF THE INVENTION

Tilting door systems, methods and related devices.

BACKGROUND OF THE INVENTION

The invention relates to doors for buildings such as airplane hangars, farm equipment storage buildings, marine storage buildings, heavy equipment storage buildings, garages, commercial & residential, and the like. It is known for such buildings to have doors that pivot up to an open position to allow the stored equipment to be moved into or out of the building. For door openings wider than about eight feet (8'), conventional sectional overhead doors are typically not used because of the span and the problem of preventing door panel sections from sagging in the middle as the door is opened. It is known for a single panel door to include a truss to support the door to preclude sagging of the door in the open position.

Reference is herein made to the following art which is also herein incorporated by reference for teachings of the general state of the art as it relates to conventional and known tilt-up doors in contrast to which, surprisingly, the present invention provides a unique contribution to the possibilities for achieving the objectives common to these references and the present invention, namely, provision of a tilt-up door: "Betker" (U.S. Pat. Nos. 8,245,446; 8,539,716; 8,769,871; 9,091,107; 9,015,996; 9,404,301; 9,428,951; and 10,208,529); "Edwards" (U.S. Pat. No. 4,765,093); "Petrat" (U.S. Pat. No. 9,273,507), and "Crown" (U.S. Pat. No. 9,631,418).

SUMMARY OF THE INVENTION

The invention relates to a tilt-up door for a building having a relatively wide door opening to be closed by a door having dimensions that are substantially equal to, but sufficiently less than the dimensions of the door opening to permit the tilt-up door to freely open from and close into the door opening. The tilt-up door according to this invention is tilted to a vertical closed position in a closing cycle, and, in an opening cycle, is tilted to a generally or substantially horizontal open position. During a closing cycle, the tilt-up door moves from the substantially horizontal open position to the substantially vertical, closed position.

The tilt-up door according to this invention in its closed vertical position includes a door frame comprised of two vertical columns with a roller assembly as well as roller assembly supports. The door panel is comprised of a bottom rail, top rail (each also commonly referred to as "girts") and left and right vertical side member, as further described herein below, along with further members, including, for example, one or more trusses, clips, fasteners, panel track assembly, weather seals, and the like, all designed to accommodate a variety of external cladding options.

In one embodiment, in its closed, vertical position, each of the at least two left and right vertical side members includes a pivot point positioned between the top and bottom horizontal members thereof, to permit pivoting of the tilt-up door around the pivot points as the door is opened and closed. Pivot points, including pivot shafts and the like, are well known in the art and may be used in any configuration to permit the tilt-up door according to this invention to rotate about each pivot point, as needed and as further described herein below.

In a preferred embodiment according to this invention, the door frame includes first and second cams, each connected to one of the at least two vertical side members of said tilt-up door, each of said cams affixed at its lower aspect to each side member at a position at or slightly above the center point of the door frame, and each cam extending upwardly and arcuately toward the interior of the building, to a point in space where said cam contacts a cam follower which is extended inwardly at approximately a right angle with respect to both the adjacent top horizontal member, and to the vertical member to which it is fixed at its proximate end, thereby causing the door to open into its horizontal position by following each said cam, and to be lowered into its vertical closed position, also by following each said cam.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an elevational view of a tilt-up door **100** according to the invention installed in an appropriately dimensioned opening in a building, viewed from the inside **400** of a building in which it is installed toward the exterior **500** thereof, with the door in its vertical, substantially closed position.

FIG. **2** shows the door **100** viewed from the right side of the view depicted in FIG. **1** with the door **100** in its substantially vertical, closed position.

FIG. **2**A shows the door **100** viewed from the right side of the view depicted in FIG. **1** with the door **100** in its substantially horizontal, open position.

FIG. **3** shows the door **100** viewed directly from the inside **400** of a building in which it is installed toward the exterior **500** thereof, with the door **100** in its substantially vertical, closed position.

FIG. **3**A shows the door **100** viewed directly from the inside **400** of a building in which it is installed toward the exterior **500** thereof, with the door **100** in its substantially horizontal, open position.

FIG. **4** shows the door **100** viewed directly from the inside **400** of a building in which it is installed toward the exterior **500** thereof, with the door **100** in its substantially vertical, closed position.

FIG. **4**A shows the door **100** along the section line **4**A-**4**A with the door **100** in its substantially vertical, closed position.

FIG. **5** shows the door **100** in a substantially vertical closed position.

FIG. **5**A shows the door **100** in a position intermediate substantially open and substantially closed positions.

FIG. **5**B shows the door **100** in a substantially open position.

FIG. **5**C shows a side view of the door **100** in a substantially vertical closed position.

FIG. **5**D shows a side view of the door **100** in a position intermediate substantially open and substantially closed positions.

FIG. **5**E shows a side view of the door **100** in a substantially open position.

FIG. **5**F shows a top view of the door **100** in a substantially vertical closed position.

FIG. **5**G shows a top view of the door **100** in a position intermediate substantially open and substantially closed positions.

FIG. **5**H shows a top view of the door **100** in a substantially open position.

DETAILED DISCLOSURE OF THE PREFERRED EMBODIMENTS OF THE INVENTION

Those skilled in the art relating to doors for large buildings such as airplane hangars, farm equipment storage

buildings, marine storage buildings, heavy equipment storage buildings, garages, and the like, will appreciate from the present disclosure the novel and inventive features of this invention, which provides an advancement and contribution to the art. This invention is particularly applicable to but is not exclusively useful with reference to such buildings having doors that pivot up to an open position to allow the stored equipment to be moved into or out of the building. For door openings wider than approximately eight feet (8'), conventional sectional overhead doors are typically not used because of the span and the problem of preventing door panel sections from sagging in the middle as the door is opened, and to be sufficiently structurally sound to withstand wind loads, as well as positive and negative loads in the course of location and rotation of the door panel between its open and closed positions. It is known for a single panel door to include a truss to support the door to preclude sagging of the door in the open position. Those skilled in the art will appreciate that while the present invention is particularly applicable to closure of openings wider than eight feet (8') and may be applicable openings somewhat smaller than that or openings several fold larger than that. Commercial or domestic garage doors are included in applications for the present door and system.

The invention relates to a tilt-up door for a building having a relatively wide door opening to be closed by a door having dimensions that are substantially equal to but sufficiently less than or slightly more than the dimensions of the door opening to permit the tilt-up door to freely open from and close into or over the door opening. The tilt-up door according to this invention is tilted to a vertical closed position in a closing cycle, and, in an opening cycle, is tilted to a generally or substantially horizontal open position. The tilting style door disclosed herein is used in structures where large openings allow for the movement of larger materials or equipment, venues where the need for people in large settings such as arenas to enter and exit, as well as permitting the opening of a side of a building to convert an enclosed building structure into an open structure. Those skilled in the art will appreciate that the term "substantially" as a modifier of open, closed, vertical or horizontal, means that the mechanisms disclosed herein can be operated to completely or incompletely open, close, set at a vertical or horizontal position, and slight deviations from absolute closure or opening, vertical or horizontal position, do not depart from the scope of this invention and the appended claims.

Definitions and Numbering of Elements of Various Aspects and Embodiments of the Invention

Various embodiments of the invention will be further understood with reference to the FIGS. **1-5** provided with this patent application filing, which show various embodiments, views, cross-sections, and angles of elevation, as needed to emphasize and make clear different aspects of the invention. In these Figures, like elements in the various views are identically numbered or are not numbered at all to avoid obscuring the various views by adding un-necessary numbering. The numbering convention followed in the figures is:

For elements of the invention which constitute the tilt-up door **100** itself, including the door frame, the door panel(s), the numbering used is in the 100-199 series.

The numbering of elements in the 200-299 series is reserved for use in describing structures which are essentially fungible to the invention, but which are preferably present in one form or another defining an opening in a building, in the context of which embodiments of the invention cooperatively interact including elements of the invention in the 100-199 and 300-399 series of elements of the tilt-up door **100** such that it operates correctly as described herein to open and close thus revealing and closing the opening in a building. All structures in the 200-299 series are shown in dashed lines as not formally constituting the invention, as the invention as described herein may operate perfectly well without such elements being present.

The 300-399 series of elements of the invention is utilized in relation to Support Structure and Actuation elements of the invention for causing the interacting mechanisms of the 100-199 series of elements, including for example, providing power, drive mechanics, to open or close the tilt-up door **100**.

The 400 and 500 series of numbers provide orientation of the views, as shown in each figure, in relation to the inside **400** and outside **500** of a building in which the tilt-up door **100** and associated mechanisms in the 200-399 series, as described herein, is installed. Thus, the depiction of the present invention shown in FIG. **1** is viewed from within 400 a building when viewed toward the exterior **500** of a building, having a sufficiently large opening of appropriate dimensions to accommodate the installation of the tilt-up door **100** according to this invention disclosure.

Accordingly, as used herein, the following terms have the following meanings:

Cam—a track made of durable material, preferably metal, of such shape as described herein, including an arcuate but flat surface, also including a channel, to guide a Cam Follower, which rides on the Cam Surface and as necessary, including where a channel is provided, the Cam Surfaces, as shown, described, and exemplified in the accompanying and non-limiting drawings, e.g. see FIG. **1**, elements **115** and **116**, each of which is affixed to the tilting component of the door **100**, including the door frame and associated components in the 100-199 series of elements.

Cam Follower—includes but not limited to a roller or like mechanism of sufficient durability to ride on the Cam Surface(s), as shown, described, and exemplified in the accompanying and non-limiting drawings, e.g. see FIG. **1**, elements **311** and **312**, and the related elements in the 300-399 series of elements.

Door Frame—means the door frame defined by vertical and horizontal elements **101-104**, their juncture points at **105-108**, cross brace **109** and its juncture points with the frame elements **110-111** and related elements of the 100-199 series of invention elements.

Support and Actuation Structure, **300**, referred to herein as stiles or columns, as described herein are affixed to a floor, including, e.g. by being bolted to concrete, as shown, described, and exemplified in the accompanying and non-limiting drawings, including e.g. as shown in FIGS. **1**, **303** and **304**, on either side of the door **100**. The Support and Actuation Structures and the related elements in the 300-399 series of elements, may be further stabilized for example by being bolted or welded or included within the U-shape of U- or I-shaped beams if such are used to form components in the 200-299 series of components, reserved for describing structures which are essentially fungible to the invention, but which are preferably present in one form or another defining an opening in a building, in the context of which embodiments of the invention cooperatively interact. Thus, those skilled in the art should understand that the invention as disclosed herein may be free-standing, or it may be bolted to, or incorporated into the structures defining an opening in

a building. While implemented in a distinctly different device and system, an example of the incorporation of Support and Actuation Structures into the U-shaped beams forming the opening of a building can be found in, for example, Betker, U.S. Pat. No. 8,245,446, herein incorporated by reference for its teaching, for example, at column 5, lines 12-64. The stiles are preferably reinforced so as to minimize load on the surrounding building and wall opening structures.

The types of tilting doors known in the art range from swings, to folding, and lifting, type doors. They have used hydraulic, screws, cables, sheaves, chains and other various actuators, as disclosed and exemplified in detail in the art cited herein above.

The balancing tilting style door of the present invention allows for a reduction in the steel requirements for the framing of the building itself and creates a partial canopy outside the opening as well as inside, when the tilt-up door **100** is in its open position.

In one embodiment according to this invention, the balancing tilt-up door **100** and its related systems as described herein, comprises:

Support Structures, **300**, also referred to herein as stiles or columns, are fixed to a stationary base such as concrete as designed by a structural engineer, on either side of a door opening in a building. The columns secure the actuation system which may include but are not limited to: hydraulics, screws, chains, cable, belts, chain over hydraulic, or the equivalent, all of which may be encompassed within the stiles of said Support Structures **300**. The drive system for opening and closing the tilt-up door **100** of this invention is powered by a conventional control panel or remote buttons that send a signal to a programmable logic controller or, in its simplest form, to power one or more motors, as exemplified in detail herein below, to raise and lower the pivot points **113** and **114**. Preferably the Support Structure contains all of the actuation mechanisms described in the 300-399 series of elements which, in combination with the 100-199 series of elements forms an operative system of the invention, whether structures in the 200-299 series of components are present or not.

A control system for actuating the movement of the door between its open and closed positions can be operated via wired or wireless analog, digital, WiFi, BLUETOOTH®, or like communication and powering channels, alone or in combination. The actuators or hydraulics mounted to the door frame or door jamb, move a pivot point on the door frame, causing the door to rise out of the closed position and to the open position as further described herein below.

Preferably, cams, mounted on the door frame, are provided with an engineered path that enables the door to open at a desired pre-determined degree, up to roughly 90 degrees or from a vertical plane to a horizontal plane. The actual degrees the door can move may be less than 90 degrees for purposes of water shed toward the exterior of the opening. The cams are fixed to the door frame forming a channel that allows a rolling cam follower affixed to the Support and Actuation Structure **300** at the upper end thereof and extended to the correct location in three-dimensional space by cam follower support bars, to fit inside the annular space of each cam, to thereby define the path that the door travels as the cam follower rides within each cam. This space can vary depending upon the system and the desired engineered path. This guide also serves as a stabilizing point for the upper portion of the door system when in the full upright position.

Detailed Description of Preferred Embodiments Exemplified in the Figures

With reference first to FIG. **1**, which provides an elevational view from the inside of a building **400**, toward the exterior **500**, the view of which is obstructed by the tilt-up door **100** according to this invention, shown in its substantially closed, substantially vertical position. In this view can be seen an embodiment of the tilt-up door **100** including and comprising a door frame formed at least from a top **101** and a bottom **102** horizontal member, and at least two vertical side members, **103** and **104**, connected to the top horizontal member at corners **105** and **106** and to the bottom horizontal member at corners **107** and **108** at opposite ends of the top and bottom horizontal members, to form a substantially square or rectangular frame for the tilt-up door **100**, depending on the substantially equal length of the top and bottom members **101** and **102** in relation to the substantially equal length of the two vertical side members **103** and **104**.

Optionally, but preferably, the tilt-up door **100** further comprises at least one reinforcing cross-brace or strut **109** affixed to both the left and the right vertical members **103** and **104** at or near the midpoint **110** and **111** of each such vertical member, or at regular intervals there-along. Optionally, not shown, either instead of or in addition to said at least one reinforcing cross-brace or strut **109**, similar but vertically oriented reinforcing cross-braces or struts are may in addition be provided, affixed to said top **101** and said bottom **102** horizontal members, to said cross-brace or strut **109**, if present, either more or less in the middle of each such horizontal member, or at regular intervals there-along. Of course, diagonal arrangements of cross-braces and struts would be included within the ambit of the claims appended to this disclosure, whether alone or in any combination with vertical or horizontal cross-bracing or struts.

Those skilled in the art will appreciate that the frame of the tilt-up door **100** of this invention as described above, comprises members **101**, **102**, **103**, **104**, and **109**, affixed to each other at points **105**, **106**, **107**, **108**, **110**, and **111**. Each member of said door panel is manufactured or manufacturable by methods known in the art, from a wide variety of engineered materials, including but not limited to, aluminum, steel, various alloys, and combinations thereof. The fixation points, **105**, **106**, **107**, **108**, **110**, and **111**, are optionally secured to each other by various means and methods known in the art, including but not limited to via welds, bolts, brackets, or the equivalent. Furthermore, those skilled in the art will appreciate that enclosed within the door frame defined by members **101**, **102**, **103**, **104**, and **109**, affixed to each other at points **105**, **106**, **107**, **108**, **110**, and **111**, there is provided a barrier **112**, which itself may be manufactured from one or more sheets of metal, including but not limited to aluminum, steel, various alloys, and combinations thereof, wood, plastic, or other materials of sufficient strength and of sufficiently light-weight material to create a stable, solid and impervious barrier to the outside of the building, **500** as is required under the circumstances. Such considerations would also dictate the need for more than the non-limiting single cross brace **109** exemplified in FIG. **1**, as described herein above. All peripheral edges of barrier **112** are, of course, preferably, affixed to door frame components defined by members **101**, **102**, **103**, **104**, and **109** by methods known in the art, including but not limited to via welding, riveting, bolting, clamping, grommets and tie-downs, or equivalents thereof. Points of fixation of **112** include at least the four corners defined at **105**, **106**, **107**, and **108**, and preferably also points **110** and **111** of **109**. Of

course, in a most preferred embodiment, the points of fixation are all along, all peripheral edges of barrier **112**.

As depicted in FIG. **1**, the view of the tilt-up door **100** is from the interior of a building **400**, with the tilt-up door **100** in its vertical, closed position, thus obscuring the exterior **500** of the building. The space in the building into which the door **100** is installed is defined in this figure by elements in the 200-299 series defining an opening in a building **200**, including but not limited to top beam **201**, left- and right-side beams **202** and **203** respectively. Each such beam may include a web and spaced flanges forming a generally U-shaped channel connected to the building and extend vertically along opposite sides of the door opening with the generally U-shaped channels facing each other and the door opening. Those skilled in the art will appreciate that even in the absence of top beam **201**, the present invention would operate perfectly well as there is no requirement that such a beam be present, nor, in fact is it required for beams **202** or **203** to be present. Accordingly, all elements in the 200-299 series of components described herein are shown in dashed lines in the figures.

As is shown, the tilt-up door **100** includes, affixed to each said vertical member **103** and **104**, pivot points, **113** and **114**, each affixed to a point on each vertical member **103** and **104** of the door frame of the tilt-up door **100**, as shown, and as further shown and described herein below. It should be noted that pivot points **113** and **114** are situated at, near, slightly above, or slightly below the midpoint of each vertical member **103** and **104**, with respect to the horizontal members **103** and **104** of the frame so as to accommodate pivoting of the door frame as required to permit cam followers **309** and **310**, as described further herein below, to follow the arcuate inwardly directed path defined by cams **115** and **116**. The tilt-up door **100**, as needed, rotates around each said pivot point, **113** and **114**, as the door is moved between its closed, vertical position and its open, horizontal position, as further described herein below. As also further described herein below, and as can be seen in FIG. **1** and subsequent figures and views, pivot points **113** and **114** are or may be conjoined with pivot translation points, **321** and **322**, so that when such points translate upward or downward, this causes the pivot points **113** and **114** to likewise translate upward or downward, while also permitting the tilt-up door **100** to pivot as needed, as directed by cams, as further described below.

In a preferred embodiment according to this invention, the tilt-up door **100** includes first and second cams **115** and **116**, each respectively affixed to one of the at least two vertical side members **103** and **104** of said tilt-up door **100**, each of said cams affixed at its lower, proximal, end to each side member **103** and **104** respectively, at a fixation point **117** and **118** at or slightly above the center point of the vertical side members **103** and **104** of the door frame, each said cam **115** and **116** extending arcuately both upwardly and inwardly toward the interior **400** of the building, to a distal end thereof **309** and **310**, respectively, said distal ends **309** and **310** each, respectively, engaging with a cam follower, **311** and **312**, as further described herein below. Each said cam follower **311** and **312**, is borne at the distal end of each of two substantially horizontally oriented cam follower support bars **305** and **306**, each oriented at approximately a right angle with respect to both the adjacent top horizontal member **101**, and to each vertical member **103** or **104**. Each cam follower support bar **305** and **306** is affixed at the proximate end thereof to a point **307** and **308** to each support column **300** sufficiently near the top end of each said support structures at **301** and **302** to properly position the distal ends thereof to enable each cam follower **311** and **312** to ride within and follow each cam **115** and **116** when pivot translation points **321** and **322** and conjoined pivot points **113** and **114** translate upward or downward, while also permitting the tilt-up door **100** to pivot as needed.

From the foregoing disclosure, it will be apparent to those skilled in the art that the door frame contains an integral track or cam which is substantially elliptical having a radius such that each integral track rides on a stationary Cam Follower, including but not limited, to for example, on a stationary steel, polyester, or other material forming a roller, which allows the frame to tilt into position as the Cam Follower rides within and in contact with the Cam. The actuation system is mounted on or in columns on either side of the door to allow the door to move into the various open and closed positions. Each cam may have an initial substantially straight and vertical portion, an arcuate portion having a defined radius, and a final, substantially straight portion. Alternatively, those skilled in the art will appreciate that the cam may simply define an arcuate path with a defined, substantially circular or elliptical radius, and variations therein as needed for a particular tilt-up door **100** installation.

Each support structure **301** and **302** is affixed to the ground by means known in the art, including but not limited to, via bolting to the ground by known fixation means, including but not limited to use of "all thread"), fixed in concrete set in the ground, at the bottom ends, **303** and **304**, thereof. Each such column, for added stability, is preferably also affixed to the door frame vertical structures, **202** and **203**, if present, by means known in the art, including but not limited to via welds, bolts, brackets, or the equivalent and combinations thereof.

In a preferred embodiment, each said support structure, **301** and **302**, is preferably hollow but also sufficiently strong to contain and support all of the elements and functionalities required by the elements of each embodiment of this invention, as described herein.

Each said support structure, **301** and **302**, is represented in FIG. **1** and subsequent figures as a column, preferably, but not necessarily exclusively, made from steel, with any steel shape, as appropriate for the size of the door. Each said column is of sufficient strength and height so that each preferably contains and supports actuator mechanisms, known in the art, including, for example, motors, hydraulics, cables, or the like, which, when actuated, causes pivot translational points **321** and **322** to be raised or lowered to desired vertical points, including the extrema corresponding with the substantially horizontal, substantially open, and the substantially vertical, substantially closed positions of the tilt-up door, **100**, and to every and any intermediate position desired, achieved by interruption of the operation relevant actuator mechanisms, such as are known in the art and which are described further herein below.

Actuator mechanisms are known to achieve, for example, and not by way of limitation, vertical translation up and down of said pivot translational points **321** and **322**. By way of further example and not limitation, in one embodiment according to the invention, motors **313** and **314**, represented in FIG. **1**, are provided. When motors **313** and **314** are concurrently activated, and retained in synchrony with each other using control mechanisms, as well as power, and circuitry requirements, known in the art, including in the herein-above cited art, a length of for example, threaded drive mechanism, or the like to act as a screw-drive, preferably rotatably engaged, at a top end thereof with each said motor, and at the bottom end thereof, is rotatably affixed to

a support within each said support structure, **301** and **302**. Each said drive mechanism is preferably enclosed within each said support structure **301** and **302** and is caused by each said motor **311** and **312** to rotate, clockwise or counter-clockwise, depending on whether the intention of the operator is to open or close the tilt-up door **100**.

Thus, for example, when each motor is caused to rotate in a said clockwise or counter-clockwise direction, viewed from above, each said pivot translation point, **321** and **322**, is caused to translate vertically upward or downward along each threaded drive due to inclusion of appropriately matching threads, as part of each said pivot translation points, **321** and **322**, to cause each pivot point **113** and **114** which are or may be conjoined with pivot translation points, **321** and **322**, to move so that when such points translate upward or downward, this causes the pivot points **113** and **114** to likewise translate upward or downward, while also permitting the tilt-up door **100** to pivot as needed.

As pivot points **113** and **114** are affixed to vertical members **103** and **104** and to pivot translation points **321** and **322**, channels **323** and **324** defined in each of said support structures, **301** and **302**, are provided, vertically above the resting point depicted in FIG. **1** for a substantially vertical, substantially closed position of the tilt-up door **100**, to permit the connection between these elements to travel freely and be guided by the engineered tracks **323** and **324**. Each said track system, **323** and **324**, acts as a guide because each such pivot point **113** and **114**, is pivotally affixed to a point on each vertical member **103** and **104** of the frame of the tilt-up door **100**, at, near, slightly above, or slightly below the midpoint between the top and bottom horizontal members **101** and **102** of the frame so as to accommodate pivoting of the door frame as required to permit cam followers **309** and **310** to follow the arcuate inwardly directed path defined by cams **115** and **116**. Thereby, the tilt-up door **100** rotates around each said pivot point, **113** and **114**, to permit movement of the door between a substantially closed, substantially vertical position and a substantially open, substantially horizontal position. To lock the door in its substantially vertical, substantially closed position, a lock mechanism **120** is provided whereby a rod is dropped through a slot in the bottom member **102** into a preferably reinforced hole or receptacle in the ground. Before the door is moved from its substantially vertical, substantially closed position, to its substantially horizontal, substantially open position, the lock mechanism is disengaged by lifting the rod out of the receptacle in the ground.

Referring now to FIGS. **2** and **2**A, each showing a side view of the tilt-up door **100** as shown in FIG. **1**, installed in a building, but viewed from a position wherein the interior **400** of the building is to the left of the viewer and the exterior **500** of the building to the right of the viewer. In FIG. **2**, the tilt-up door **100** is depicted in a substantially closed, substantially vertical position. In FIG. **2**A, the tilt-up door **100** is depicted in a substantially open, substantially horizontal position. Also evident are various elements in the 200-399 series of elements which are best seen when viewed from this perspective.

FIGS. **3** and **3**A show the door **100** viewed directly from the inside **400** of a building in which it is installed toward the exterior **500** thereof, with the door **100** in its substantially vertical, closed position (FIG. **3**), and in its substantially horizontal, open position, (FIG. **3**A), respectively. The top edge **101** can be seen in FIG. **3**A, tilted into the interior **400** of a building. The position of the pivot translation points **113/321** and **114/322** at their lowest, substantially closed, substantially vertical position of the door **100** can be seen in FIG. **3**, while in FIG. **3**A, the position of the pivot translation points **113/321** and **114/322** at their highest, substantially open, substantially horizontal position of the door **100** can be seen.

FIGS. **4** and **4**A show the door **100** viewed, in FIG. **4**, directly from the inside **400** of a building in which it is installed toward the exterior **500** thereof, with the door **100** in its substantially vertical, closed position, and in FIG. **4**A, with the door **100** in its same substantially vertical, substantially closed position, but viewed from the side along section lines **4**A-**4**A, toward the far end of the door **100**. In these views, engineered track **323** can best be seen, as can the fixation point **117** of the proximal end thereof to vertical frame member **103** is also clearly shown.

FIGS. **5**-**5**H provide a series of elevational views (FIG. **5**, FIG. **5**A, and FIG. **5**B), a series of side views (FIG. **5**C, FIG. **5**D, and FIG. **5**E), and a series of top views, (FIG. **5**F, FIG. **5**G, and FIG. **5**H), of the tilt-up door **100** according to the invention installed in an appropriately dimensioned opening in a building; wherein, in each series of views, the left-most view (FIGS. **5**, **5**C, and **5**F), the door **100** is shown in an initially substantially vertical, substantially closed position, while in the middle views, (FIG. **5**A, FIG. **5**D, and FIG. **5**G), the door is shown in a position intermediate substantially open and substantially closed, and in the right hand series of views (FIG. **5**B, FIG. **5**E, and FIG. **5**H), the door is shown in its substantially horizontal, substantially open position, respectively.

While exemplified herein above by motors **313** and **314**, the drive mechanism for causing each pivot point and pivot translation point **113/321** and **114/322**, alternative motive mechanisms known in the art may be included, instead of or in addition to said motors. For example, such mechanisms may include vertically extending hydraulic cylinders, each including a piston which is vertically movable with a distal end connected to the pivot point and pivot translation point **113/321** and **114/322** to cause motion thereof when activated. Likewise, alternatively, the tilt-up door **100** may include cables connecting the first and second pivot translation points to the actuator, and the actuator can be a linear actuator positioned above the door opening and can have the moving portion connected to the cables to move the pivot point and pivot translation point **113/321** and **114/322**. Alternately the actuator can be a winch positioned above the door opening and the cables can be connected to the winch drum to move the pivot point and pivot translation point **113/321** and **114/322**. The tilt-up door **100** can include cables with a first end anchored to an anchor positioned adjacent to top of each of the vertical columns **300**. Each of the first and second carriages can include a pulley and the cables can pass over the pulley and the second end of the cables can be connected to the actuator (e.g. a motor) to move the first and second pivot point and pivot translation point **113/321** and **114/322**. Alternatively, the tilt-up door **100** can further include first and second pulley blocks that can have a pulley and a connector and the pulley blocks can be slidably carried in a slot of the vertical columns **300**.

Those skilled in the art, based on the present disclosure, will appreciate that various embodiments of the tilt-up door **100** may include, for example, a passage door or like access doors, windows, and the like within the door frame for access to the building, without the need to open the entire door. Other modifications, variations, embellishments, or equivalents of the various elements of the invention come within the scope of the appended claims. Furthermore, while the invention has been specifically described in connection with certain specific embodiments thereof, it is to be under-

stood that this is by way of illustration and not by way of limitation. For the scope of the invention disclosed herein, reference should be had to the appended claims and their equivalents.

What is claimed is:

1. A tilt-up door for a building, the building having a door opening to be closed by said tilt-up door when in a vertical closed position, the door being movable in an opening cycle to a generally horizontal open position and being movable in a closing cycle from the open position to the closed position, said door comprising, when in said closed position:

a. a door frame including at least top and bottom horizontal members, and at least left and right vertical side members each connected to the top and bottom horizontal members at opposite ends of the top and bottom horizontal members and a barrier affixed to said door frame;

b. each of the left and right vertical side members includes a pivot point positioned between the top and bottom horizontal members of said door frame, said pivot points engaged with an actuation mechanism which when powered raises or lowers said pivot points;

c. first and second cams, each mounted to a respective one of the vertical side members of said door frame, a lower end of each of said cams is affixed to the respective one of the vertical side members at a position at or slightly above a point approximately half-way down the respective one of the vertical side members, and each said cam extending from the lower end thereof upwardly and arcuately toward an interior of the building to a distal upper terminal end of said cam, said distal upper terminal end of each of said first and second cams contacts a cam follower, said cam followers extend toward each other approximately at a right angle with respect to said vertical side members and parallel to the top horizontal member, wherein as the door moves between the closed position and the open position, the cam followers slide along the first and second cams and guide the first and second cams and the door; and

d. said actuation mechanism, when powered, causes each said pivot point to move, thereby causing the door to move between the open and closed positions.

2. The tilt-up door according to claim **1**, wherein said actuation mechanism is substantially housed within at least one support structure adjacent said door opening.

3. The tilt-up door according to claim **1**, wherein each said cam follower is mounted to a distal end of a substantially horizontally oriented cam follower support bar, each said support bar is mounted to a support column adjacent said door opening and is oriented at approximately a right angle with respect to the top horizontal member and to each of said vertical side members, when the door is in the closed position.

4. The tilt-up door according to claim **3**, wherein interaction between said cams and said cam followers cause said door to follow an arcuate path as the door is moved between the open and closed positions.

5. The tilt-up door according to claim **4**, wherein said actuation mechanism comprises an actuator connected to the pivot points and operable to cause said pivot points to move vertically upward or downward, whereby the door is mounted for vertical movement and for tilting movement about said pivot points when the actuator is operated.

6. The tilt-up door according to claim **5**, wherein the actuator comprises first and second motors which, when activated, cause rotation of first and second drive screws which causes said pivot points to move.

7. The tilt-up door according to claim **5**, wherein the actuator comprises vertically extending hydraulic actuators, each said hydraulic actuator having a vertically movable piston having a distal end thereof connected to a respective one of the first and second pivot points.

8. The tilt-up door according to claim **5**, wherein the actuator comprises a linear actuator and cables.

9. The tilt-up door according to claim **5**, wherein the actuator comprises a drum and cables.

10. A system comprising a tilt-up door for a building, said building having a door opening to be closed by said tilt-up door when in a vertical closed position, the door being movable in an opening cycle to a generally horizontal open position and being movable in a closing cycle from the open position to the closed position, said door comprising, when in said closed position:

a. a door frame including at least top and bottom horizontal members, and at least first and second vertical side members each connected to the top and bottom horizontal members at opposite ends of the top and bottom horizontal members and a barrier affixed to said door frame;

b. each of the vertical side members includes a pivot point positioned between the top and bottom horizontal members of said door frame, said pivot points engaged with an actuation mechanism which when powered raises or lowers said pivot points;

c. first and second cams, each mounted to a respective one of the vertical side members of said door frame, a lower end of each of said cams is affixed to the respective one of the vertical side members at a position at or slightly above a center point of the door frame, and each said cam extending from the lower end thereof upwardly and arcuately toward an interior of the building to a distal upper terminal end of said cam, said distal upper terminal end of each of said first and second cams contacts a cam follower, said cam followers extend toward each other approximately at a right angle with respect to said vertical side members and parallel to the top horizontal member, wherein as the door moves between the closed position and the open position, the cam followers slide along the first and second cams and guide the first and second cams and the door; and

d. said actuation mechanism, when powered, causes each said pivot point to move, thereby causing the door to move between the open and closed positions.

11. A method of closing a door opening of a building, comprising:

a. providing a door having a vertical closed position and being movable in an opening cycle to a generally horizontal open position and being movable in a closing cycle from the open position to the closed position;

b. providing a door frame including at least top and bottom horizontal members, at least left and right vertical side members each connected to the top and bottom horizontal members at opposite ends of the top and bottom horizontal members and a barrier fixed to said door frame;

c. each of the left and right vertical side members includes a pivot point positioned between the top and bottom horizontal members of said door frame, said pivot points engaged with an actuation mechanism which when powered raises or lowers said pivot points;

d. providing first and second cams, each mounted to a respective one of the vertical side members of said door frame, a lower end of each of said cams is affixed to the respective one of the vertical side members at a posi-

tion at or slightly above a point approximately half-way down the respective one of the vertical side members when the door is in the closed position, and each said cam extending from the lower end thereof upwardly and arcuately toward an interior of the building to a distal upper terminal end of said cam when the door is in the closed position, said distal upper terminal end of each of said first and second cams contacts a cam follower when the door is in the closed position, said cam followers extend toward each other approximately at a right angle with respect to said vertical side members and parallel to the top horizontal member, wherein as the door moves between the closed position and the open position, said cam followers slide along the first and second cams and guide the first and second cams and the door; and

e. said actuation mechanism, when powered, causes each said pivot point to move, thereby causing the door to move between the open and closed positions.

* * * * *